



FINAL STUDY REPORT
East Texas Plant Materials Center
Nacogdoches, Texas

Assembly and Evaluation of Little Bluestem Accessions for Conservation in Eastern Texas and Western Louisiana

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ABSTRACT

Little bluestem [*Schizachryium scoparium* (Michx.) Nash] is a native, warm season grass used for wildlife habitat and forage. The USDA-Natural Resources Conservation Service (NRCS) in Texas and Louisiana were interested in a prevarietal little bluestem release to increase diversity in conservation cover and wildlife habitat in their respective states. The objective of this study was to evaluate the performance of eighty-seven wild collected accessions of little bluestem from Texas and Louisiana to identify germplasm for use in a prevarietal release program. Three commercial little bluestem releases ('Aldous', 'Cimarron' and OK Select Germplasm) were included as standards. Little bluestem collections were planted and evaluated at the USDA-NRCS East Texas Plant Materials Center (ETPMC), Nacogdoches, Texas. Accessions were evaluated for foliage abundance, disease resistance, seed amount and stem lodging from 2006 and 2007. Accessions were similar in disease resistance, seed amount and stem lodging. However, there were significant differences between accessions in foliage abundance. From the assembly, five accessions (9067237, 9067257, 9067279, 9067292, and 9067345) were chosen for further testing because of their better ratings in foliage abundance, disease resistance, seed amount and stem lodging.

INTRODUCTION

Little bluestem is one of the major tall grasses of the prairie along with big bluestem (*Andropogon gerardii* Vitman), switchgrass (*Panicum virgatum* L.), and Indiangrass [*Sorghastrum nutans* (L.) Nash] (Diggs et al., 2006). It is a native perennial warm season bunchgrass adapted throughout the United States (except, Alaska, Oregon, and Nevada) and Canada (USDA NRCS, 2014) in areas which receive 25 inches or more of annual rainfall (Wolff, 1951). This grass is found in prairies, open woods, clearing and roadsides on sites in full sun with well drained soils (Missouri Botanical Garden, 2014). Although little bluestem grows on a range of soils, it is best adapted to limestone derived calcareous soils (Leithead et al., 1971). Growth of little bluestem begins in spring, continues until early fall, and seed matures in October and November (Hatch and Pluhar, 1995).

Little bluestem is utilized for forage and hay production (Diggs et al., 2006). Cattle readily graze this forage in the spring and early summer (Weaver, 1968). On open forest sites in the longleaf pine range, little bluestem is a dominant plant often producing 50% or more of the forage and during winter, standing little bluestem residue is a roughage source for cattle (Grelen and Hughes, 1984). This warm season grass must be properly managed. Cassady (1953) reported a reduction in forage production and stand density of little bluestem when it was closely clipped and repeatedly harvested during a growing season. As a result, during the next growing season less forage was produced and lower value plants invaded the stand.

Little bluestem is applicable for use in wildlife habitat. Skipper butterflies use little bluestem as a larval host (Steiner, 2010). In Texas, little bluestem provides suitable habitat for the lesser prairie chicken (*Tympanuchus pallidicinctus*) (Taylor and Guthery, 1980). Bobwhite quail (*Colinus virginianus*) populations, which use this grass for cover and nesting, have declined about 10% in the last eighteen years. One of the possible causes for this decline could be the extensive planting of monoculture forages such as bermudagrass which reduced the amount of suitable habitat (Texas Parks and Wildlife, 2014 and 2014a.). White tail deer (*Odocoileus virginianus*) is the dominant game animal in east Texas (Texas Parks and Wildlife, 2014b). Deer graze on this grass and use it as a screening cover (Leithead et al., 1971 and Tyrl et al., 2008). Planting a superior little bluestem release would enhance wildlife habitat for these species.

The objective of this study was to assemble and evaluate little bluestem germplasm from Texas and Louisiana in a common garden at the USDA-NRCS East Texas Plant Materials Center (ETPMC) and identify superior ecotypes for developing a prevarietal release for conservation cover and wildlife habitat.

MATERIALS AND METHODS

From 2002 to 2004, NRCS personnel from east Texas and Louisiana made eighty-seven wild collections of little bluestem seed (Table 1). Three commercial standards; ‘Aldous’ released in 1966 by the USDA-NRCS Manhattan PMC, Manhattan, KS; ‘Cimarron’ released in 1979 by the USDA-NRCS Manhattan PMC, Manhattan, KS; and OK Select Germplasm released by the USDA-NRCS James E. “Bud” Smith PMC, Knox City, TX were included in the evaluation.

In March 2005, RLC4 cone-tainers (Ray Leach, Stuewe and Sons, Tangent, OR) were filled with Pro-mix BX medium (Premier Tech Horticulture, Quakertown, PA) and seeds from each collection were planted into the medium. The seedlings were grown under greenhouse conditions prior to transplanting to the evaluation nursery. A smooth, weed free seedbed was prepared prior to transplanting by disking and cultipacking. In June 2005, the seedlings were transplanted on one foot spacing in nonreplicated plots with 40” row spacing in an evaluation nursery at the USDA-NRCS ETPMC near Nacogdoches, TX. Soil types were Woden and Attoyac fine sandy loams (both thermic typic Paleudalfs). Weeds were controlled by hand and mechanical cultivation. The transplants were watered at time of planting to aid establishment. The remainder of the evaluation was conducted under dry land conditions.

Accessions were visually rated in 2006 and 2007 for foliage abundance, disease resistance, seed amount, and stem lodging on a scale of 1=excellent, 3=good, 5= fair, 7=poor, 9=very poor or dead. Boot and bloom dates, average foliage height, average plant width, and average mature plant height were recorded. The boot and bloom dates were recorded when 50% of the plants in a plot attained these respective seed development stages. Foliage height was determined by measuring in inches from ground level to the top of the foliage from three

plants/plot. The sum of the measurements was then divided by three to calculate average foliage height/plot. Plant width was determined by measuring three plants/plot. Plants were measured horizontally across the widest part of the foliage to calculate plant width. The foliage leaves were not stretched but left untouched. The sum of the measurements was then divided by three to calculate average plant width/plot. Mature plant height was measured in inches from ground level to the top of the tallest reproductive stem of each plant. The sum of the measurements was then divided by three to calculate average mature plant height.

Data taken in 2006-2007 were averaged over years and analysis of variance was used to determine differences in foliage abundance, disease resistance, seed amount, and stem lodging using Statistix[®] 8 (Analytical Software, 2003). Means that differed significantly were separated at the 5% level of probability.

RESULTS AND DISCUSSION

Of the original assembly of eighty-seven accessions (Table 1), eight accessions exhibiting no or low seed germination or poor seedling vigor in the greenhouse were eliminated from the evaluation. During the field nursery evaluation, thirteen accessions were eliminated due to incorrect species (broomsedge bluestem (*Andropogon virginicus* L.) and splitbeard bluestem (*Andropogon ternarius* Michx.), succumbed to disease, no plant uniformity within the plot, or very late seed development (not completing seed development before average first frost date at the ETPMC).

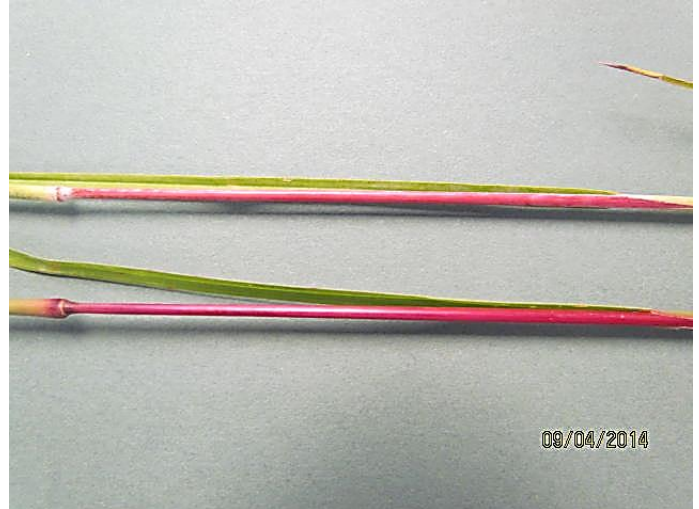
Yatskievych (1999) notes there is a wide variation in appearance of little bluestem, ranging from bluish gray color (strongly glaucous) to green with little or no glaucousness. Among the accessions in the assembly, there were two phenotypes that fit within this description. The first phenotype was green with smooth stems and foliage. The second phenotype was a two tone combination of smooth blue stems and green foliage. Some of the accessions of these phenotypes exhibited red internodes along the stem. The third dominant phenotype (exhibited by many collections from Louisiana) was solid green with long, shaggy hairs along the stem and leaf sheath. Hitchcock (1951) describes pinehill bluestem [*Schizachyrium scoparium* var. *divergens* (Hack.) Gould] as having long hairs on the leaf sheath. Judging from their appearance, these collections may have been pine hill bluestem. Pine hill bluestem is a common species variant in east Texas and Louisiana pine forest range (Grelen, 1974). Pine hill bluestem is a near relative of little bluestem and the two species are very similar in appearance (Grelen and Duvall, 1966).



Above: Phenotype 1 – Green appearance with smooth stems and red internodes.



Above: Phenotype 2 - combination of blue smooth stems and green foliage.



Above: Close up of red internodes. The top internode is from a blue stem/green foliage phenotype plant. The bottom internode is from a smooth stem/green foliage phenotype plant.

Among the remaining sixty-six accessions there were significant differences in foliage abundance ($P=0.0000$) however, there were no significant difference among accessions for disease resistance ($P=0.3059$), seed amount ($P=0.1637$) or stem lodging ($P=0.2783$). Average study ratings were as follows: foliage abundance (5.1), disease resistance (5.7), seed amount (5.4), and stem lodging (5.3). The majority of average ratings by accession ranged from 5 to 9 (Table 2). Accessions which performed at or above average ratings (4 to 5) in the evaluation criteria were considered for further testing. Fifty-three accessions received below average (6 to 9) ratings in at least one evaluation criteria and were eliminated from consideration for further testing. Of the remaining thirteen accessions, six were eliminated because they resembled pinehill bluestem. The five accessions chosen for further testing (Table 3) received at or above average study ratings for foliage abundance, disease resistance, seed amount and were above a 6 rating for stem lodging.

Table 3. Average study ratings for little bluestem accessions chosen for further testing. USDA-NRCS East Texas Plant Materials Center, Nacogdoches, Texas.

Accession Number	Foliage Abundance	Disease Resistance	Seed Amount	Stem Lodging
9067237	5.0*	5.0	4.5	5.5
9067257	5.0	5.0	4.5	5.5
9067279	4.5	5.0	4.5	4.5
9067292	4.0	5.0	5.0	5.5
9067345	5.0	5.0	4.5	5.5

*Visual ratings were recorded annually in 2006 and 2007. Ratings were on a scale of 1=excellent to 9=very poor.

CONCLUSION

From an assembly of eighty-seven wild collected little bluestem accessions, eighty-two were eliminated from the evaluation because of no or low seed germination, poor seedling vigor, incorrect species collection, or below average performance in the evaluation criteria. These seed collections will be stored in a controlled environment at the USDA-NRCS ETPMC. Five collections (9067237 (Leon Co., TX); 9067257 (Robertson Co., TX); 9067279 (Burleson Co., TX); 9067292 (Guadalupe Co., TX); and 9067345 (Robertson Co., TX)) were chosen for further testing because of above or average ratings in foliage abundance, disease resistance, and seed amount.

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Table 1. Origin of little bluestem accessions from Texas and Louisiana. USDA-NRCS East Texas Plant Materials Center, Nacogdoches, Texas.

Accession	County or Parish of Origin	Accession	County or Parish of Origin
9067216	Chambers, TX	9067224*	Henderson, TX
9067226	Madison, TX	9067237	Leon, TX
9067251	Matagorda, TX	9067252	Matagorda, TX
9067257	Robertson, TX	9067258	Robertson, TX
9067259	Robertson, TX	9067263	Freestone, TX
9067266	Nacogdoches, TX	9067268	Fayette, TX
9067271	Bell, TX	9067279	Burleson, TX
9067283	Lee, TX	9067288	Mills, TX
9067292	Guadalupe, TX	9067297	Waller, TX
9067318	Nacogdoches, TX	9067322	Nacogdoches, TX
9067324	San Augustine, TX	9067325	San Augustine, TX
9067328*	Henderson, TX	9067330	Cooke, TX
9067336	Freestone, TX	9067345	Robertson, TX
9067346	Robertson, TX	9067352	Matagorda, TX
9067353	Burleson, TX	9067354	Burleson, TX
9067355	Burleson, TX	9067680	Winn, LA
9067681**	Winn, LA	9067682	Lasalle, LA
9067683**	Lasalle, LA	9067684**	Lasalle, LA
9067685**	Grant, LA	9067686	East Feliciana, LA
9067687	East Feliciana, LA	9067688	Rapides, LA
9067689**	Caldwell, LA	9067690	Caldwell, LA
9067691	Caldwell, LA	9067692	Union, LA
9067693	Bienville, LA	9067694	Bienville, LA
9067695	Winn, LA	9067696	Winn, LA
9067697	Rapides, LA	9067698**	Rapides, LA
9067699	Rapides, LA	9067700	Rapides, LA
9067701	Vernon, LA	9067702	Vernon, LA
9067703	Vernon, LA	9067704	Vernon, LA
9067705	Beauregard, LA	9067706	Beauregard, LA
9067707	Iberville, LA	9067708**	Allen, LA
9067709	Allen, LA	9067710	Rapides, LA
9067711	Rapides, LA	9067712**	Calcasieu, LA
9067713	Natchitoches, LA	9067714	Natchitoches, LA
9067715	Desoto, LA	9067716	Caddo, LA
9067717	Red River, LA	9067718	Rapides, LA
9067719	Grant, LA	9067720	Vermilion, LA
9067721	Acadia, LA	9067722	Acadia, LA
9067723	Evangeline, LA	9067724	Rapides, LA

Table 1 (cont'd)

Accession	County or Parish of Origin	Accession	County or Parish of Origin
9067727	Tangipahoa, LA	9067728	Vermilion, LA
9067200	Robertson, TX	9067222	Nacogdoches, TX
9067206	Nacogdoches, TX	9067228	Walker, TX
9067208	Freestone, TX	9067267	Nacogdoches, TX
9067249	Rusk, TX	9067725	Vermilion, LA
9067726	Jefferson Davis, LA		

*not little bluestem

**no or low germination or poor seedling vigor in greenhouse, not included in field evaluation

Table 2. Average evaluation criteria ratings of little bluestem assembly 2006-2007. USDA-NRCS East Texas Plant Materials Center, Nacogdoches, Texas.

Accession Number	Fol Abun*	Dis Res*	Stem Lodg*	Seed Am*	Foliage Height (cm.) ¹	Plant Width (cm.) ²	Mature Height (cm.) ³	Boot Date ⁴	Bloom Date ⁴
9067200	5cde ^{5/}	5	6	4.5	64	73	157	5-Jul	Aug-14
9067206	5cde	5	5	5	49	73	149	4-Jul	10-Aug
9067208	5cde	6	5	5	57	71	162	5-Jul	1-Aug
9067222	3.5 f	5	6	5	69	75	130	3-Jul	26-Sep
9067228	5 cde	5	5	5	60	66	166	5-Jul	21-Aug
9067237***	5 cde	5	5.5	4.5	58	70	151	5-Jul	21-Aug
9067251	3.5 f	6	7	5	60	74	150	20-Oct	**
9067252	4 ef	6	6	5	51	69	149	3-Aug	20-Sep
9067257***	5 cde	5	5.5	4.5	58	68	159	5-Jul	19-Aug
9067258	5 cde	5	6	4.5	60	64	157	15-Jul	16-Aug
9067259	4.5def	5	6	4.5	61	72	165	30-Jun	29-Jul
9067263	5cde	6	7	5	52	70	160	5-Jul	14-Aug
9067266	6abc	6	5	5	40	55	141	3-Jul	25-Aug
9067267	5cde	5	6	5	27	43	110	5-Aug	9-Sep
9067271	5cde	5	7	5	48	62	142	8-Jul	21-Aug
9067279***	4.5def	5	4.5	4.5	63	71	160	8-Jul	8-Sep
9067283	5cde	6	6	5	52	60	159	5-Jul	21-Aug
9067288	6.5ab	6	4.5	6	42	56	121	5-Jul	29-Jul
9067292***	4ef	5	5.5	5	69	76	152	12-Jul	25-Sep
9067322	5cde	6	5	6	28	45	90	23-Aug	19-Sep
9067324	5cde	5	5	5	43	68	116	23-Aug	23-Sep
9067325	5cde	6	5	5	33	50	102	27-Jul	22-Sep
9067345***	5cde	5	5.5	4.5	57	71	165	5-Jul	14-Aug
9067346	5cde	5	5	5	52	70	147	8-Jul	12-Aug
9067690	5cde	5	5	5	34	58	131	19-Jul	19-Aug
9067705	5cde	6	5	6	36	59	133	24-Jul	12-Sep
9067726	5cde	7	5	7	33	60	120	24-Jul	6-Oct
9067727	5cde	7	5	6	34	67	121	6-Jul	10-Sep
9067728	4.5def	6	5	6	41	67	100	20-Sep	**
9067716	5cde	6	5	5	45	64	145	12-Jul	27-Aug
9067710	5cde	6	5	5	27	54	107	27-Jul	24-Sep
9067719	5cde	6	5	5	49	73	152	19-Jul	8-Sep
9067720	5cde	6	5	5	36	64	133	20-Aug	29-Sep
9067721	3.5f	6	4.5	5	49	65	138	20-Jul	19-Sep
9067722	5cde	5	5	6	37	52	122	18-Jul	4-Sep
9067723	5cde	6	5	6	34	58	120	24-Aug	24-Sep
9067725	5cde	7	6	7	46	60	131	**	**
9067216	5.5bcd	7	5	8	40	72	101	**	**

Table 2 Cont'd

Accession Number	Fol Abun*	Dis Res*	Stem Lodg*	Seed Am*	Foliage Height (cm.) ¹	Plant Width (cm.) ²	Mature Height (cm.) ³	Boot Date ⁴	Bloom Date ⁴
9067226	5cde ^{5/}	7	5	6	33	61	121	5-Jul	29-Jul
9067249	5cde	6	5	5	45	67	135	27-Jul	24-Aug
9067268	5cde	6	5.5	5.5	48	63	131	15-Sep	**
9067297	5cde	5	7	5	45	61	129	5-Jul	19-Sep
9067318	7a	6	5	6	25	40	101	6-Jul	20-Aug
9067330	6abc	6	5	6	44	57	135	5-Jul	1-Sep
9067336	5cde	6	6	4.5	53	73	165	5-Jul	14-Aug
9067352	3.5f	5	5	5	35	43	124	6-Oct	**
9067680	7a	7	6	6	20	24	96	18-Jul	23-Aug
9067682	5cde	7	5	5	34	43	126	5-Jul	16-Aug
9067686	7a	7	7	5	43	36	120	6-Jul	11-Sep
9067687	5cde	5	6	6	16	20	92	29-Jul	11-Sep
9067688	5cde	6	5	6	49	41	140	29-Jul	4-Sep
9067691	5cde	5	5	5	28	34	141	29-Jul	21-Aug
9067692	5cde	5	5	5	41	47	143	5-Jul	17-Aug
9067693	5cde	6	5	5	35	40	126	17-Jul	26-Aug
9067694	6abc	6	5	7	34	38	116	5-Jul	1-Sep
9067695	5cde	5	5	5	50	45	146	9-Jul	14-Aug
9067696	5cde	5	5	5	37	43	138	10-Jul	19-Aug
9067697	5cde	5	5	5	32	42	118	12-Aug	17-Sep
9067699	5cde	6	5	6	44	41	125	20-Aug	15-Sep
9067700	5cde	6	5	5	18	22	92	24-Jul	25-Sep
9067701	5cde	5	5	5	55	43	143	27-Jul	1-Sep
9067702	5cde	5	5	6	22	27	116	20-Aug	17-Sep
9067703	5cde	5	5	5	45	51	137	27-Jul	19-Sep
9067704	5cde	6	5	6	44	38	115	16-Aug	26-Sep
9067706	5cde	6	6	6.5	44	39	132	4-Aug	11-Sep
9067711	5cde	6	5	6	40	45	133	8-Jul	23-Aug
9067713	5cde	6	6.5	5.5	40	42	125	10-Jul	3-Sep
9067714	4.5 def	5	5	5	28	34	112	6-Jul	11-Sep
9067715	7a	7	5	6	27	30	105	5-Jul	1-Sep
9067717	5cde	7	5	5	38	34	122	27-Jul	17-Aug
9067718	6abc	6	5	6	47	42	101	15-Aug	18-Aug
9067724	5cde	5	5	6	45	48	115	14-Jul	17-Sep
9067353	5cde	6	6	5	23	26	137	7-Aug	7-Sep
9067354	5cde	6	6	5	28	22	110	7-Aug	1-Sep
9067355	6abc	5	6	5	30	29	136	7-Aug	10-Sep
9067707	7a	6	6	6	23	33	98	3-Jul	14-Sep
9067709	5cde	5	5	7	23	23	93	16-Aug	14-Sep

Table 2 Cont'd

Accession Number	Fol Abun*	Dis Res*	Stem Lodg*	Seed Am*	Foliage Height (cm.) ¹	Plant Width (cm.) ²	Mature Height (cm.) ³	Boot Date ⁴	Bloom Date ⁴
OK Select	5cde ^{5/}	5	5	5	23	23	105	6-Jul	1-Sep
Aldous	6abc	5	5	6	18	20	100	6-Jul	14-Aug
Cimarron	6abc	5	6	5	17	19	90	6-Jul	28-Aug

*Visual ratings for the evaluation criteria were based upon a scale of 1=excellent, 3=good, 5=average/fair, 7=poor, 9=very poor/dead

**Denotes no boot or bloom date recorded. These accessions were delayed in seed development and did not progress to boot or bloom stages.

***Accessions highlighted in yellow were chosen for further testing.

1/ = Foliage Height was determined by measuring three plants/plot from ground level to the top of the abundance of foliage.

2/ = Plant Width was determined by measuring three plants/plot at the widest part of the foliage.

3/ = Mature Plant Height was determined by measuring three plants/plot. Plant measurements taken at seed maturity from ground level to the top of the tallest reproductive stem of each plant.

4/= Boot and Bloom. The boot and bloom dates were recorded when 50% of the plants reached boot and bloom seed development stages.

5/ = Means in column followed by the same letters are not significantly different at the 5% level of probability.

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